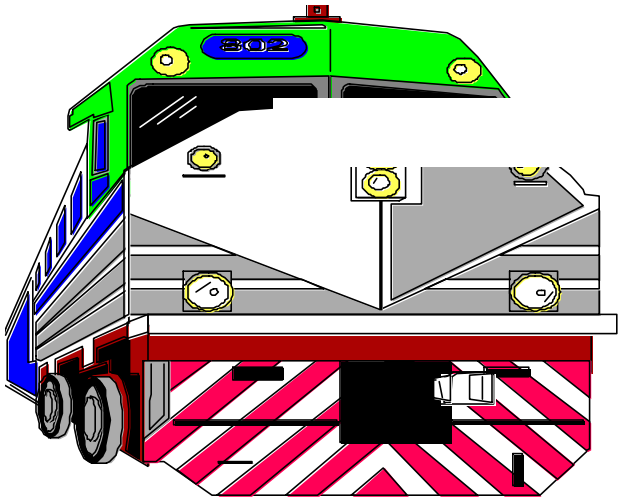


ASCAP BRIEFING

22 OCTOBER 2002

Professor Ted C. Giras

ASCAP BRIEFING TOPICS

- **CSX CBTM STATUS**
  - DTC: TRAFFIC EXPOSURE ALGORITHM (TEA)
  - TRAIN DYNAMIC MOVEMENT
  - SEVERITY – MISHAP CLASSIFICATION
  - RANDOM NUMBER GENERATOR
  - HUMAN-FACTORS

- **ASCAP++ LESSONS LEARNED EXTENSIONS**
  - CTC: TRAFFIC EXPOSURE ALGORITHM (TEA)
  - CTC WAYSIDE INTERLOCKING
  - CAB SIGNALING
  - BLACKBOARDS
  - MAINTENANCE-OF-WAY (MOW)
  - MULTI-STATE DEVICE PROBABILISTIC BEHAVIOR
  - EVENTS PASSED AT DANGER (EPADS) – FAULT TREES
  - EPAD LOGS
  - SEVERITY & MISHAPS

CSX DTC-CBTM STATUS

- ***OVERVIEW***
  - GENETIC ALGORITHM USED TO IDENTIFY TMA HIDDEN PARAMETERS
  - HYBRID TRAIN DYNAMIC MOVEMENT MODEL INSTALLED
  - FRA/CSX DEVELOPING TMA STRING CHARTS TO VERIFY ASCAP TMA
  - EVENT PASSED AT DANGER LOGS COMPLETED
  - RANDOM NUMBER GENERATOR PERFORMANCE VERIFIED
  - HUMAN-FACTORS CALIBRATION COMPLETE
  - SEVERITY – MISHAP MODEL COMPLETED
- ***FINAL PRESENTATION TO "PEER REVIEW" GROUP REQUIRED***

WHAT ARE THE ASCAP++ LESSONS LEARNED ?

- OVERVIEW
  - CTC TRAFFIC EXPOSURE ALGORITHM (TEA)
  - TRAIN DYNAMIC MOVEMENT MODEL
  - CTC WAYSIDE INTERLOCKING
  - CAB SIGNALING
  - BLACKBOARDS
  - MAINTENANCE-OF-WAY WORKERS (MOW)
  - MULTI-STATE DEVICE PROBABILISTIC BEHAVIOR
  - EVENTS PASSED AT DANGER (EPADS) – FAULT TREES
  - SEVERITY & MISHAPS

CTC: TRAFFIC EXPOSURE ALGORITHM (TEA)

- DEFINES THE COMPUTER AIDED DISPATCH TRAIN MOVEMENT CAPABILITIES
- TEA IS PARTITIONED AS FOUR(4) SEGMENTS:
  - COMPUTER AIDED DISPATCH (CAD) SCHEDULING
  - MEET/PASS CONFLICT RESOLUTION
  - IMPLEMENTS TRAIN CONSIST PRIORITIES
  - TRAIN DYNAMIC MOVEMENT MODEL
  - TRAIN CONSIST AND MOW EQUIPMENT MOVEMENT

TRAIN DYNAMIC MOVEMENT MODEL

- HYBRID TRAIN DYNAMIC MODEL INSTALLED WITH THE FOLLOWING FEATURES:
  - DAVIS EQUATION, GRAVITY, LENTHG, TRACTION EFFORT
  - FOR DISCRETE EVENT SIMULATION POLYNIOMALS PROVIDE FOR EACH SPEED ZONE THE FOLLOWING:
    - AVERAGE SPEED VERSUS WEIGHT/POWER RATIO (LENGTH)
- MISHAP POTENTIAL DETECTION USES CONTINUOUS SIMULATION:
  - ACTIVATED WITH AN EVENT PASSED AT DANAGER
  - INTERGRATED WITH HUMAN-FACTORS
  - PROVIDES TRAIN MOVMENT DYNAMIC VECTOR

CTC WAYSIDE INTERLOCKING

- WAYSIDE SIGNAL CONTROLS DEFINED BY BOOLEAN EQUATIONS TO PERFORM THE FOLLOWING TYPICAL FUNCTIONS:
  - FUNCTION OF TRACK OCCUPANCY
  - FUNCTION OF CAD TRAIN ROUTE LOCKING
  - PREVENTS DISPATCHER FROM ASSIGNING CONFLICTING ROUTES
  - BOOLEAN EQUATIONS USED TO SIMULATE SIGNALING LOGIC

CAB SIGNALING

- CAB SIGNING MODEL HAS BEEN DEVELOPED WITH THE AID OF US&S AND UP:
- THE FOLLOWING MAJOR ELEMENTS ARE CONSIDERED:
  - ON-BOARD AUTOMATIC TRAIN PROTECTION (ATP)
  - FOUR(4) ASPECT ON-BOARD DISPLAY
  - LOCOMOTIVE TRACK CIRCUIT READER
  - TRACK CIRCUIT INTEGRATION
  - WAYSIDE SIGNAL INTEGRATION

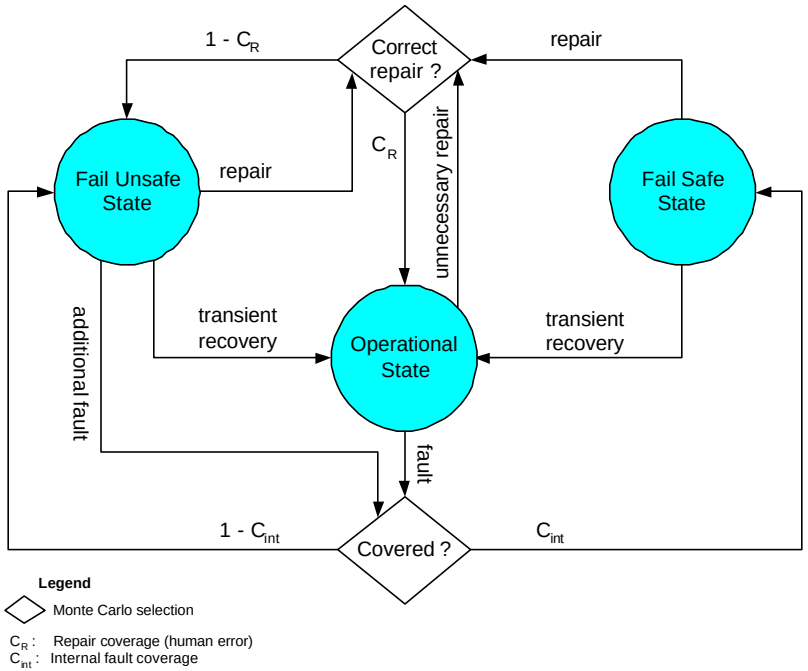
Human Factors Model

- Supports train crew, dispatcher and mow
  - Voice control
  - Train handling
- Model Parameters
  - Probability of recognition
  - Probability of interpretation
  - Probability of coverage
  - Probability of compliance
- Integrated with the Dynamic Train Model
- Integrated with CTC Signaling Blackboards

MOW Model

- Supports predefined or dispatcher generated work zones:
  - Dispatchers can spawn work zones due to train crews reporting equipment failures encountered while in route
  - Dispatchers can set up overlapping work zones
  - Dispatcher can can improperly revoke work zone limits (give a clear to a train crew while MOW still working)
  - Dispatchers can improperly set speed too high in work zones.
- Voice control provided by EIC
- Work zones marked by flags
  - Flags may be missing or inappropriately displayed.
- MOW workers may work outside assigned work zone

Multi-State Model



- Captures appliance behavior
  - Incorporates transient behaviors
  - Incorporates improper repair effects
- Model Parameters
  - Failure rate (includes effects of transient & permanent)
  - Hardware/software Coverage
  - Repair
  - Human repair coverage

Events Passed At Danger (EPAD)

- Identify train exposure to either an agent violation or an object hazard
- Trigges the potential for a mishap pair condition
  - Simulation trigger to check mishap conditions
  - Either precede or are coincident with a mishap
- ASCAP calculated the last past six Events Passed at Danger(EPADS)
- EPADS equivalent to PHA Fault Tree construction

SEVERITY & MISHAPS

- Severity calculated based on both Historical and Expert Opinion:
  - Societal cost for each Mishap estimated based on historical data comparison with ASCAP variables obtained from the Train Consist Dynamic Behavior
  - Historical data is not sufficient and must be supplemented with Expert Opinion
  - Mean and Variance calculated for each Mishap to determine Non-Accident versus Accident
  - Accident history documented as an FRA Accident Report

EPAD Logs

- CONTENT DERIVED TO SUPPORT:
  - ASCAP HISTORICAL DATA MINING
  - CONSTRUCTION OF EPAD INFORMATION
    - PROBABILISTIC BEHAVIOR
    - OPERATIONAL RULE BOOK COMPLIANCE –NON COMPLIANCE
  - SUPPORT SEVERITY- MISHAP MODEL
    - PROVIDE DATA TO DETERMINE NON ACCIDENT - ACCIDENT

CONCLUSION(S)

- PROPOSE AN ASCAP WORKSHOP FOR NEXT RSAC SESSION:
  - ONE DAY SESSION
  - WEB-BASED DEMONSTRATION
- OTHER INFORMATION:
  - COLLABORATION WITH CHINA BEING ESTABLISHED
  - UVA CENTER TO BE DULPLICATED AT SHANGHI UNIVERSITY
  - CHINA FALCULTY TO BE IN RESIDENCE AT UVA BY DECEMBER